

Claims

- [c1] A method for monitoring a nitridation process, comprising:
- (a) providing a semiconductor substrate;
 - (b) forming a dielectric layer on a top surface of said substrate;
 - (c) introducing a quantity of interfacial species into said substrate;
 - (d) measuring the density of interface traps between said substrate and said dielectric layer;
 - (e) providing a predetermined relationship between said quantity of said interfacial species and said density of said interface traps; and
 - (f) determining the quantity of said interfacial species introduced based on said relationship.
- [c2] The method of claim 1, wherein said interfacial species is selected from the group consisting of nitrogen, oxygen, carbon and germanium.
- [c3] The method of claim 1, wherein said relationship is in the form of a graph, an equation or a table.
- [c4] The method of claim 1, wherein said dielectric layer in-

cludes silicon oxide or a high dielectric constant dielectric material.

[c5] The method of claim 1, wherein said step (c) introduces said interfacial species by ion implantation, rapid thermal ammonia anneal, rapid thermal nitric oxide anneal, rapid thermal nitrous oxide anneal or nitrogen plasma.

[c6] A method for monitoring a nitridation process, comprising:

- (a) providing a semiconductor substrate;
- (b) forming a first dielectric layer on a top surface of said substrate;
- (c) introducing a quantity of interfacial species into said substrate;
- (d) removing said first dielectric layer;
- (e) forming a second dielectric layer on said top surface of said substrate;
- (f) measuring the density of interface traps between said substrate and said second dielectric layer;
- (g) providing a predetermined relationship between said quantity of said interfacial species and said density of said interface traps; and
- (h) determining the quantity of said interfacial species introduced based on said relationship.

[c7] The method of claim 6, wherein said relationship is lin-

ear within at least a range of quantity of said interfacial species introduced.

- [c8] The method of claim 6, wherein said relationship is graphical in form, in the form of an equation or in the form of a table.
- [c9] The method of claim 6, wherein said substrate is a bulk silicon substrate or a silicon-on-insulator substrate.
- [c10] The method of claim 6, wherein said interfacial species includes nitrogen.
- [c11] The method of claim 6, wherein said interfacial species includes oxygen, carbon or germanium.
- [c12] The method of claim 6, wherein said first dielectric layer includes silicon oxide.
- [c13] The method of claim 6, wherein said second dielectric layer includes silicon oxide or a high dielectric constant dielectric material.
- [c14] The method of claim 6, wherein said step (c) introduces said interfacial species by ion implantation.
- [c15] The method of claim 6, wherein said step (c) introduces said interfacial species by rapid thermal ammonia anneal, rapid thermal nitric oxide anneal, rapid thermal ni-

trous oxide anneal or nitrogen plasma.

- [c16] A system for monitoring a process for the introduction of interfacial species between a dielectric layer and a semi-conductor substrate comprising:
 - a first station for forming said dielectric layer on a top surface of said substrate;
 - a second station for introducing a quantity of interfacial species into said substrate;
 - a third station for measuring the density of interface traps in said substrate by corona discharge and for determining the quantity of said interfacial species introduced based on a predetermined relationship between said quantity of said interfacial species and said density of interface traps; and
 - means for transferring said substrate between said stations.
- [c17] The system of claim 16 further including:
 - a fourth station for removing said dielectric layer; and
 - a fifth station for forming another dielectric layer on said top surface of said substrate.
- [c18] The system of claim 16, wherein said second station includes an ion implantation tool.
- [c19] The system of claim 16, wherein said second station in-

cludes a rapid thermal ammonia tool, a rapid thermal nitric oxide tool, a rapid thermal nitrous oxide tool or a nitrogen plasma tool.

[c20] The system of claim 16, wherein said interfacial species is nitrogen.